General thoughts

Important to consider both purely biological and environmental issues (e.g., those raised by John Williams regarding how well hatchery fish can serve as surrogates for natural production fish), and more statistical issues of experiment design and measurement of variables and analysis of data. Here I focus largely on the statistical issues.

1. Begin three simple product binomial dist'ns.

   The notation is R for number released, y for number recovered, S for survival probability, p for capture probability at Chipps Island, and π for probability of recovery in an ocean fishery. Subscripts r and gs mean Ryde and Georgiana Slough, and d and o mean downstream and ocean.

   Design 1, Release upstream, Recovery downstream

$$\begin{aligned} y_{r,d} &\sim \text{Binomial}(R_r, S_r p) && (1)\\ y_{gs,d} &\sim \text{Binomial}(R_{gs}, S_{gs} p) && (2) \end{aligned}$$

   Design 2, Release upstream, Recovery downstream and ocean

$$\begin{aligned} y_{r,d}, y_{r,o} &\sim \text{Trinomial}(R_r, S_r p, S_r(1-p)\pi) && (3)\\ y_{gs,d}, y_{gs,o} &\sim \text{Trinomial}(R_{gs}, S_{gs} p, S_{gs}(1-p)\pi) && (4) \end{aligned}$$

   Design 3, Release upstream and downstream, Recovery downstream and ocean

$$\begin{aligned} y_{r,d}, y_{r,o} &\sim \text{Trinomial}(R_r, S_r p, S_r(1-p)\pi) && (5)\\ y_{gs,d}, y_{gs,o} &\sim \text{Trinomial}(R_{gs}, S_{gs} p, S_{gs}(1-p)\pi) && (6)\\ y_{d,o} &\sim \text{Binomial}(R_d, \pi) && (7) \end{aligned}$$

   Note:

   - Main use of these models is to estimate S_r/S_{gs}
   - Implicit assumption that capture rates are constant for a pair of Ryde and Georgiana releases (e.g., sampling time-area measures are ignored)
   - No explicit accounting for the effects of flow, temperature, size, exports, etc on survival.
   - No allowance for more complex relationships (e.g., schooling, heterogeneity in survival and/or capture rates within a release group $\Rightarrow$ overdispersion)

   Believe these models are useful, however, for addressing some of the following issues

(a) How and whether to use ocean recoveries (point estimates and standard error calculations)

(b) How and whether to make downstream releases (point estimates and standard error calculations)

(c) How changing release numbers and/or increasing recovery effort at Chipps Island affects precision of estimates of S_r/S_{gs}

(d) Assessing effect of non-constant p on estimates (only Design 3 allows for explicit estimation of different p's for Ryde and Georgiana Slough releases), thinking more about the way sampling effort is being used to estimate "sampling effort", and the role of efficiency study releases.

(e) Inclusion of additional upstream release sites and estimation (expanding the 3 designs).

(f) Considering some departures from the models

i. non-independence and subsequent overdispersion;

ii. non-constant p (only Design 3 allows for explicit estimation of different p's for Ryde and Georgiana Slough releases),

and how interpenetrating replicates might be useful.

2. Next, include modeling survival as a function of exports (at least)

(a) Just how to do this: choice of models

(b) Experiment design issues: levels of exports and/or range of export ratios and subsequent "power" or "estimate precision".

(c) Problems of defining covariates (e.g., average exports for 3 days) and "measurement" error in covariates

3. Then, consider more complex, detailed models which might not be necessary for addressing major questions of workshop but could be used for potentially more accurate and powerful analyses of D8 data.

(a) Continuous time models that explicitly model travel time and time Chipps Island trawl is operating, response variables include time of individual fish recovery

(b) Fuller treatment of ocean recoveries (at least breaking down by age at recovery)

(c) Models with shock coefficient

(d) Models which allow for overdispersion